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# SOLID WASTES HANDLING IN HOSPITALS. VOLUME II. SUPPORTIVE DEPARTMENTS. CHAPTER II. SOLID WASTES HANDLING

Environmental Control Administration
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## CHAPTER II. SOLID WASTES HANDLING

*Ralph J. Black*

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH SERVICE
Environmental Control Administration
*solid wastes program*
CINCINNATI
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Chapter II

# SOLID WASTES HANDLING

*Ralph J. Black*

THE DIVERSIFIED TYPES of solid wastes that must be stored, collected, and disposed of in the operation of medical care institutions create problems that should be recognized early in the planning process. Adequate facilities for the types and amounts of waste that must be handled; the location and design of waste chutes, and design of waste rooms; whether separate facilities are to be provided for the disposal of surgical and autopsy wastes; and the method of disposal are all essential factors to consider for both new or remodeled facilities. Consideration should be given to on-site incineration or hauling for off-site disposal, with emphasis on the placement and type of incinerator if incineration is chosen. Suitable storage, collection, and conveyance systems must be evaluated, keeping in mind such factors as the size of waste containers, facilities for cart and/or container washing, whether garbage grinders can be used, or whether a refrigerated room must be provided for storing the garbage until removed.

## TYPES AND VOLUME

The principal types of solid wastes are: (1) garbage, (2) paper, trash, and other dry combustibles, (3) treatment room wastes, (4) surgery wastes, (5) autopsy wastes, (6) noncombustibles such as cans and bottles. All containers and equipment should be readily cleanable, small enough for one man to handle easily when full, covered as tightly as practicable until filled, and constructed to create as little noise as possible during handling. Ideally, collection must create a minimum of disturbance, yet be scheduled frequently enough to minimize accumulation of odors and prevent overloading of storage, transportation, and disposal equipment.

Solid waste handling systems should prevent airborne contamination, vermin attraction, and odor production. The system should encourage neatness and good housekeeping, and present no safety hazards to the institution or its employees. It is particularly noteworthy that studies of the microbiological contamination of hospital air showed the heaviest contamination in waste storage and disposal areas, particularly in chute closets.[1] In view of the well-documented difficulties experienced in controlling hospital-acquired infections, good supervision must assure that the most scrupulous housekeeping standards are maintained in handling solid wastes.

Average weight and volume of solid wastes have been given by several workers as between 7 and 8½ pounds, and about 0.7 cubic foot per patient per day. Unfortunately, there is no reliable current information on average refuse production. The increasing use of disposable items has undoubtedly altered former average figures on types and quantities and has affected incinerator loadings. The problems inherent in safely disposing of such items as syringes, examination gloves, catheters, emesis basins, and petri dishes by means of outdoor storage and municipal collection, involve special safety considerations for staff, collectors, and the public. There are legal implications as well. For example, used syringes recovered from landfills or dumps by children who play doctor or use them for darts, or by narcotics addicts for less innocent purposes, may leave the hospital liable for legal action through failure to destroy or safely dispose of them.

Most existing data on waste type and volume are

Mr. Black is chief of the Solid Wastes Engineering Section, Special Engineering Services Branch, Division of Environmental Engineering and Food Protection, U.S. Public Health Service.

calculated on a pounds-per-patient-per-day basis. There are shortcomings in using the patient day as a unit for estimation, however. It has been suggested that a better correlation can be obtained by using an equivalent population computed from total patients, resident and part-time staff members, and estimated visitor load. Charts II and III, using the equivalent population basis, show the results of one waste production survey.

Single-service plastic waste receptacle liners or moisture-proof paper bags with special holders are preferable to unlined metal containers with their attendant sanitizing requirements or cloth bags which require laundering. Specially designed

***Chart II.*** **Hospital Noncombustible Wastes Production on Volume per Capita per Day Basis***

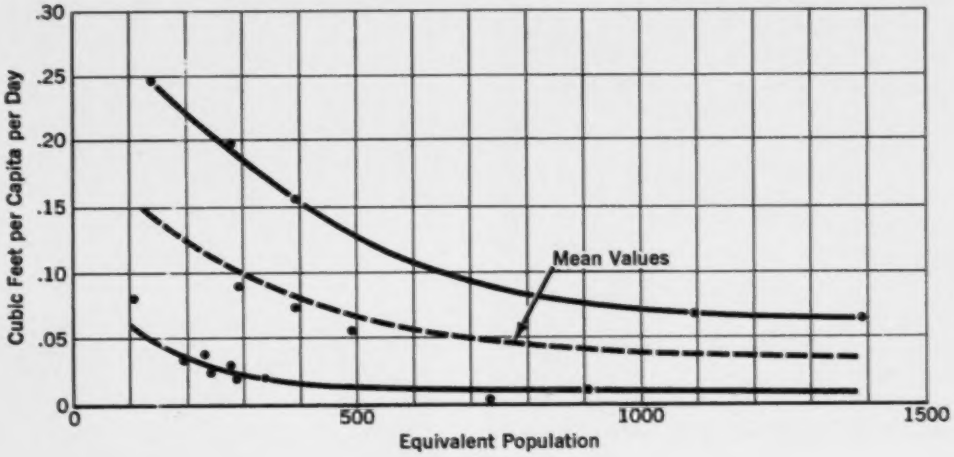
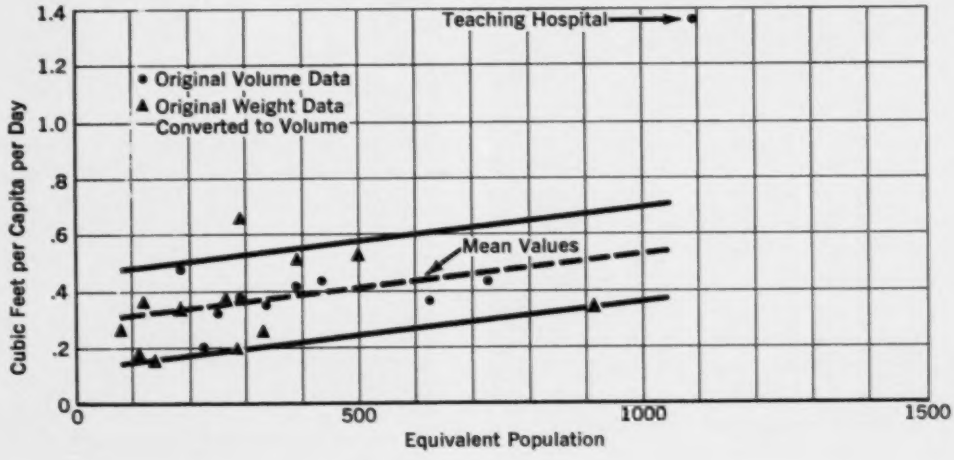



***Chart III.*** **Hospital Combustible Wastes Production on Volume per Capita per Day Basis***




* *American Journal of Public Health*, 46:382, March 1956, copyright 1956 by the American Public Health Association, Inc.

single-service cardboard cartons have also been used successfully. (See figures 3 and 4.)

Trash chutes should discharge to a trash receiving room separate from the incinerator charging areas, and the receiving room should have exhaust ventilation. Chute loading doors should be located in soiled-equipment areas or in closets separated from corridors or clean areas. Charging doors should be protected with electric interlock systems to prevent the opening of more than one door at a time, and should be tightly fitted with flexible gasketing to minimize the spread of aerosols from the chute. Chutes and trash receiving rooms should have adequate sprinklers for fire protection, and incinerator operating periods should be scheduled to minimize trash buildup in both areas. (See figure 5.)

The use of single-service container liners, paper bags, or cardboard cartons reduces aerosol spread, eliminates odor and noise produced in transferring the refuse, and achieves better vector control because the metal supports or receptacles do not accumulate much gross soil. Rupture of plastic bags of 0.0015 to 0.0020 gauge has been reported as infrequent even when used for cans and bottles. Overloading, however, particularly with wet garbage, must be controlled by staff training and supervision. After filling, liners should be closed with rubber bands or stapled. Paper bags are less liable to rupture but have thus far been employed in relatively limited quantities. (See figure 6.)

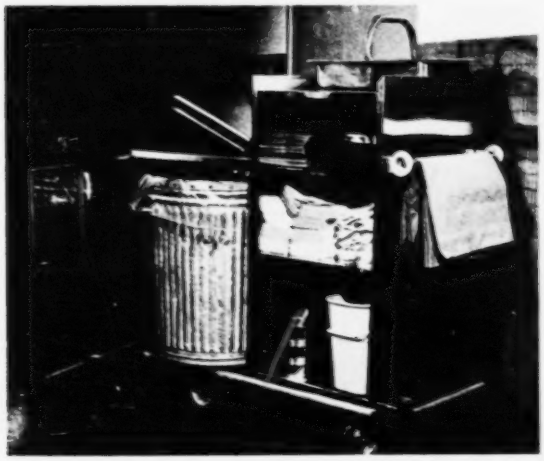


***Figure 3.*** **Housekeeping cart with bulk container lined with plastic bag.**

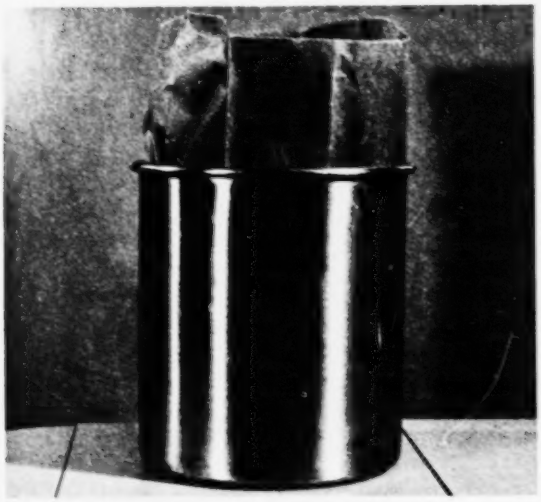


***Figure 4.*** **Trash receptacle from isolation room showing impervious paper liner. Receptacles from non-isolation rooms should also be lined.**

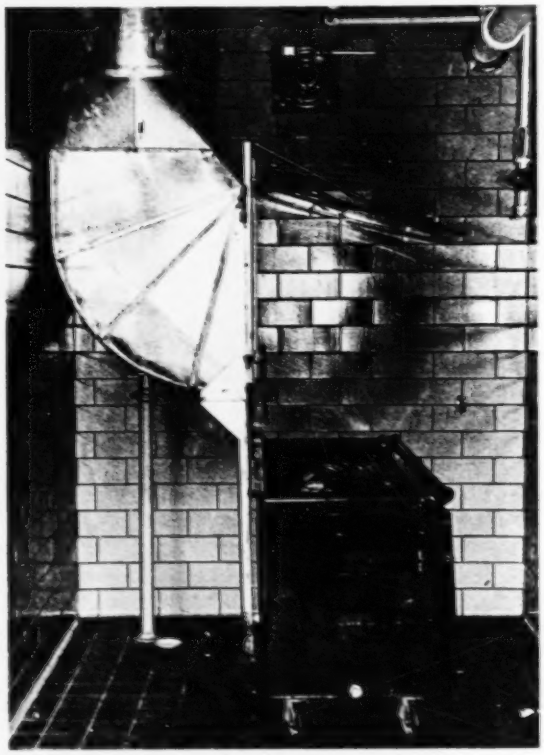


***Figure 5.*** **Trash chute receiving room should be separate from charging area, fire sprinklered and, if possible, have hose bibs to permit periodic scrubbing.**

*Figure 6.* **Paper bag for bulk trash collection mounted in special holder with stapler for closing.**

Plastic bags for larger (27 to 33 gallon) containers may not feed readily through waste chute doors; the use of smaller containers and bags or small cardboard cartons may be necessary. Metal containers from which liners are removed should have closely fitting lids, either detachable or of the hinged, foot-operated type. Containers should be constructed without open seams or crevices for easy cleaning. The container and cart-washing facilities should be located as close together as possible so that the same hot water and steam supply can be used. If steam is used, it must be under pressure to be effective in open containers or for carts. Whether 180° F. water or steam is used for sanitizing, a thorough initial hot water wash with detergent is necessary to remove the gross soil from containers. The operation should be mechanized as much as possible to reduce labor and to encourage frequent washing of this equipment. (See figures 7 and 8.)

Although impervious liners reduce the necessary frequency for sanitizing containers, all containers and the carts on which they are transported should be cleaned routinely, as frequently as facilities permit, without waiting for accumulation of clearly visible gross soil. Fabric hampers, if used to transport sealed liners, should be laundered on alternate days. They should *never* be used for carrying pathogenic wastes.

## GARBAGE DISPOSAL

Many institutions use garbage grinders. But in some areas, local ordinances prohibit the use of commercial, heavy-duty garbage grinders of the type best suited to institutional use. Special agreements, which sometimes include a service charge to cover the additional sewerage treatment load, have been negotiated between local authorities and hos-

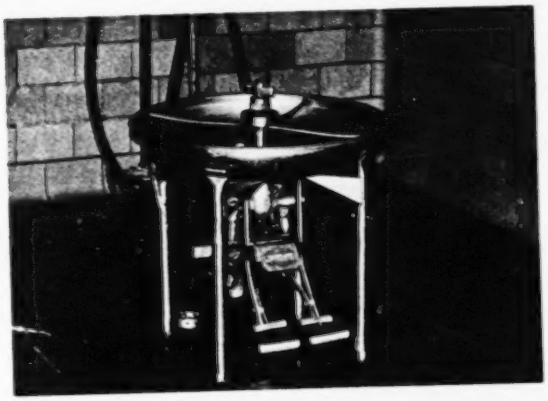


*Figure 7.* **Can cleaner with 180°F. water connections.**

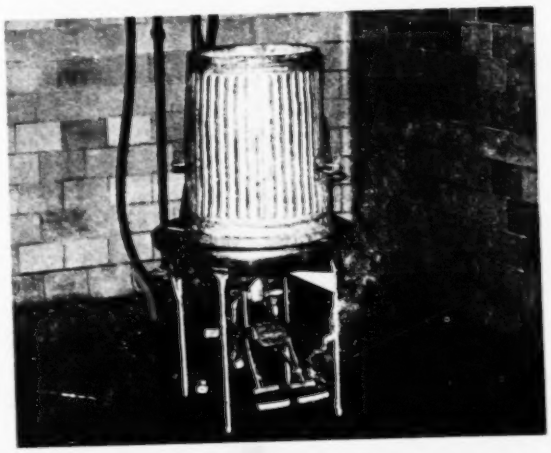


*Figure 8.* **Can cleaner with can positioned for cleaning.**

pital administrators. The use of grinding units for disposing of placental wastes and other hospital service department wastes, as well as the more customary kitchen wastes, should be evaluated.

An approximate guide for estimating commercial disposer capacity in kitchen uses is shown below:

| Horsepower | ½ | ¾ | 1½ | 3 |
|---|---|---|---|---|
| General capacity lbs/hr | 200 | 400 | 1,200 | 2,000 |
| Up to number of persons per meal | 125 | 300 | 1,500 | 1,500 plus |

The pounds-per-hour capacity is based on use of a special mixed waste developed as a military specification.

The size of grind is important in making the discharge acceptable for handling in the sewerage treatment system. The following specifications are based on the military specification used in table III:

1. 40 percent of discharge must pass a No. 8 sieve.
2. At least 65 percent shall pass a No. 3 sieve.
3. 100 percent shall pass a ½" sieve.

***Table III.*** **Basis for Determining Pounds-Per-Hour Capacity of Disposer***

| Material | Approximate Percent Drained Weight |
|---|---|
| Uncooked beef or pork bones not over 1½" diameter | 10 |
| Uncooked poultry bones | 10 |
| Grapefruit rinds cut in half | 15 |
| Green beans, cooked | 5 |
| Turnips, cooked | 5 |
| Spinach, cooked | 5 |
| Whole beets, cooked | 4 |
| Banana skins | 10 |
| Lettuce leaves, raw | 10 |
| Raw vegetable trimmings | 5 |
| Raw celery stalks | 5 |
| Corn husks | 5 |
| Potato peelings | 5 |
| Paper napkins | 4 |

* Specifications Military—G–1584OB, Para. 4.1.1.1.

The unit should be approved by Underwriters Laboratory and installed with a backflow prevention device. The impellers and fly wheel should be corrosion and jam resistant; the motor of ball-bearing, sealed design; and the unit should have an inlet deflector of neoprene or other approved elastomeric material. Approved sanitary installation principles for easy cleanability and maintenance should be followed.

If garbage cans are used, as they are in many dietary facilities on nursing floors, plastic liners are very useful in reducing the amount of gross soil that accumulates in the cans. If garbage must be sorted, rather than ground or incinerated, and hauled away at the end of a shift, refrigerated storage should be provided. This retards spoilage, reduces odor production, and greatly reduces fly and rodent attraction during warm weather. Outside storage of either garbage or rubbish requires containers that are tightly covered, easily cleanable, and positioned on a rack 12 inches off the ground for a single rack of cans, and 18 inches above the ground if a double rack is used. Galvanized pipe of 1½ inch diameter is often used to construct racks because the pipe is durable and easy to clean.

## RUBBISH DISPOSAL

Since incineration facilities must be provided for the disposal of infectious wastes, many institutions have built incinerators large enough to handle all their refuse. While enough large cardboard cartons accumulate in large hospitals to warrant flattening and selling them, the local demand for cardboard is variable. Similarly, there may be a minor local market for large-sized tin cans to be used by nurseries to plant trees and shrubs. However, such salvage does not significantly reduce the volume of refuse which must be handled.

Equipment for wet grinding or pulping of refuse, followed by dewatering of the pulp, has been introduced recently. This equipment has the advantage that both garbage and trash can be handled, and since the slurry can be pumped easily, the extracting unit can be located where removal of the dewatered pulp is convenient. Little water is used by these units because the extracted water is recycled. The principal disadvantage of this method is that a damp pulp is produced which is best disposed of by landfilling or composting.

Such specialized problems as destruction of limb or body casts can only be handled in heavy-duty, high-temperature incinerator units after first breaking the casts into small segments. One special

problem which has occurred in institutions having an appreciable amount of bone wastes, such as teaching hospitals which use numbers of experimental animals, is fused phosphorous deposits on grates or bricks in combustion chambers. These deposits, which are much harder than fused glass, are usually removed by periodic chipping or the replacement of some of the brickwork or grates.

## HOSPITAL INCINERATOR TYPES

Two principal types of multiple-chamber incinerators are currently in use—natural-draft, and heavy-duty, high-temperature. The latter is preferable because the high temperatures provide safe disposal of pathological and laboratory wastes, wet garbage, and other high-moisture-content materials. The obsolete flue-fed incinerator with direct charging from the waste chute, was convenient because it permitted loading at each floor. But it had a high level of faulty operation and breakdown, created aerosol contamination around flue doors, into hallways and patient areas, and had serious limitations on handling high-moisture wastes. The natural-draft type offers improvement in operating temperatures but little certainty of complete destruction of pathological materials. The high-temperature type of incinerator of either grate or solid hearth construction, with drying shelves for wet wastes and an auxiliary heating unit to insure temperatures of 1200° to 1800° F. is the unit of choice.

There are various devices to aid in controlling particulates in the gases emitted from an incinerator. The settling chamber provides an additional compartment in which fly-ash particles impinge on the surfaces or, if large enough, settle out as the hot gases pass through the chamber. The same effect is usually accomplished by proper design of a multiple chamber incinerator. Design of the secondary combustion chamber and its flue connection should afford a 90° angle, forcing a sharp directional change in the movement of combustion gases. The natural impingement of particles, supplementing that accomplished earlier by the baffles between the primary and secondary chambers, will remove a high proportion of particulate matter. As always, proper charging practices and sufficiently high operational temperatures are also necessary for good results.

A second device for particulate removal is the liquid scrubber or gas washer, operated on these basic principles:

**a.** Wet impingement—Particulates impinge on baffles with water flowing over their surfaces.

**b.** Water sprays—Spray jets in the flue breeching wash the gases in passing.

**c.** Water curtain—A continuous curtain is diverted by baffles through which the flue gases pass.

Particulate removal devices are designed more for air-pollution control than as safety devices to prevent emission of pathogens. Adequate destruction of pathogens is only accomplished by sufficiently high temperatures in auxiliary burning units, and particulate removal should never be viewed as a substitute for high-temperature destruction.

Heavy-duty incinerators can be equipped with a heat-exchange coil to provide hot water or steam for sterilizing waste cans. In many cases, irregular incinerator operating schedules and the relatively low BTU value of refuse, even if no high-moisture material is incinerated, offer marginal benefits. However, one author indicated that in a "fairly large" hospital, heat recovery could mean a saving of $100 or more per month.[2] The determination to make the added capital investment necessary to recover waste heat should be evaluated by a qualified mechanical engineer after data on average waste composition have been collected. Local air pollution control requirements always should be investigated before installing or modifying an incinerator installation. Detailed operating instructions should be mounted on the incinerator control panel or nearby wall. The manufacturer's representative should review operating procedures with the engineer or foreman responsible for incinerator operation and maintenance.

Classification systems have been suggested for incinerator types to furnish some guidance in selecting appropriate units.[3, 4]

## OPERATIONAL AND SAFETY CONSIDERATIONS

In organizing solid wastes disposal work, supervision must be strict and constant, with the responsibility delegated to one individual. Housemen performing collection and storage work should be carefully trained in protective techniques necessary for the proper handling of pathogenic wastes, such as the use of gloves, gown, filter mask; meth-

ods of handling containers to minimize aerosol spread; and proper closure techniques if liners are used. All wastes from infectious disease cases, including food wastes, should be placed in clearly marked plastic or paper bags and incinerated. Only trained personnel, wearing gloves or other protective items, if necessary, should handle these wastes. Pathogenic wastes from treatment rooms, burn dressing rooms, autopsy wastes, items such as sputum cups and tissues from tuberculosis wards, pathogenic laboratory wastes, and experimental animal tissues all require careful handling of waste receptacle liners, together with strict observation of protective techniques by collecting personnel.

Scheduling of collection must depend on local conditions, but refuse should be removed at frequent intervals in as sanitary and as quiet a manner as possible. Since no firm scheduling of refuse removal from operating and delivery rooms is feasible, frequent checking with supervisors is necessary to provide adequate service. If only one service hall and entrance in the building is available, the food facilities are frequently located nearby. In such cases, refuse removal should be scheduled during periods of the lowest level of food preparation and service. To minimize aerosol hazards and relieve hallways and service elevators of extra traffic, no collection should be scheduled during mealtimes. If flue-fed incinerators are still being used, particular attention must be given to training housemen and others handling wastes not to empty noncombustible or pathological wastes into the chutes. Waste receptacle liners must not be overloaded to the point that the bags are ruptured by forcing them through hopper doors. Liners should be routinely used in kick-buckets in surgery and delivery rooms. Proper training of housemen in the use of waste-can liners or cartons makes it unnecessary to use nursing personnel trained in isolation and protective techniques to handle infectious waste disposal. (See figures 9, 10, and 11.)

Medicines which contain alcohol, empty containers with residual hydrocarbon products, trash saturated with inflammable liquids, and pathogenic wastes all constitute safety hazards if spilled in the incinerator charging process or thrown into a closed-down but still hot incinerator chamber. Transparent face shields are used routinely to protect the eyes of municipal incinerator stokers, and should be used by hospital incinerator operators. Any introduction of material into the incinerator after routine operating hours should be closely supervised. When pathological remains which have been preserved in alcohol are incinerated, additional air must be provided to keep down the heat and smoke generated. The operating temperature should be brought up to about 1700° F. by auxiliary burners and blowers when starting to incinerate a new load of wastes. After the load is charged, the fuel supply should be cut off, but the blowers should be left running to provide sufficient air for good combustion.

In new installations, facilities for vacuum cleaning incinerators, rather than sweeping and shoveling, should be investigated. One municipal-sized operation reported a reduction in work force from 6 to 2 men and cleaning time reduced from 36 to 5 hours a week. Additionally, the vacuum process eliminates the need for workmen to use the protective clothing and respirators required by the manual process.[5]

Safety controls required on gas-fired incinera-

***Figure 9.*** **Bulk waste can with plastic liner for wastes from isolation area. Smaller individual can liners from patient rooms are placed in lined larger can.**

***Figure 10.*** **Houseman closing neck of liner before fastening. Note that proper sized liner cuff permits enough slack for adequate closure without compressing waste inside.**

***Figure 11.*** **Both fastened liner and tight-fitting can lid are tagged with warning tag to protect subsequent handlers and insure adequate disposal of infectious wastes.**

tors should be (1) draft indicators, (2) pilot light solenoid, (3) low voltage release relay on blower, and (4) damper interlock. All these safeguards should be in series with a solenoid shut-off valve in the gas supply line, which will operate upon failure of any of the safety components.

Routine safety inspections by insurance inspectors should be encouraged, since their training makes them sensitive to any installation where a foreseeable set of circumstances might cause accidents or fire.

Some routine operating instructions which prolong incinerator life are:

1. Clean grates and ash pits daily.
2. Keep all draft passages clean.
3. Operate dampers weekly. Pulleys may cease to function because of ash dust.
4. Keep cans, bottles, and other noncombustibles out of the incinerators.
5. Ventilate furnace well before lighting to reduce explosion hazards from accumulated fumes.
6. Don't overload furnace.
7. Keep materials stirred and loose, exposing them to air so they will burn readily.
8. Give a smoking fire more air.
9. Don't strike brickwork with bars or rakes.
10. Learn what types and amounts of wastes may safely be burned without overheating the brickwork.[6]

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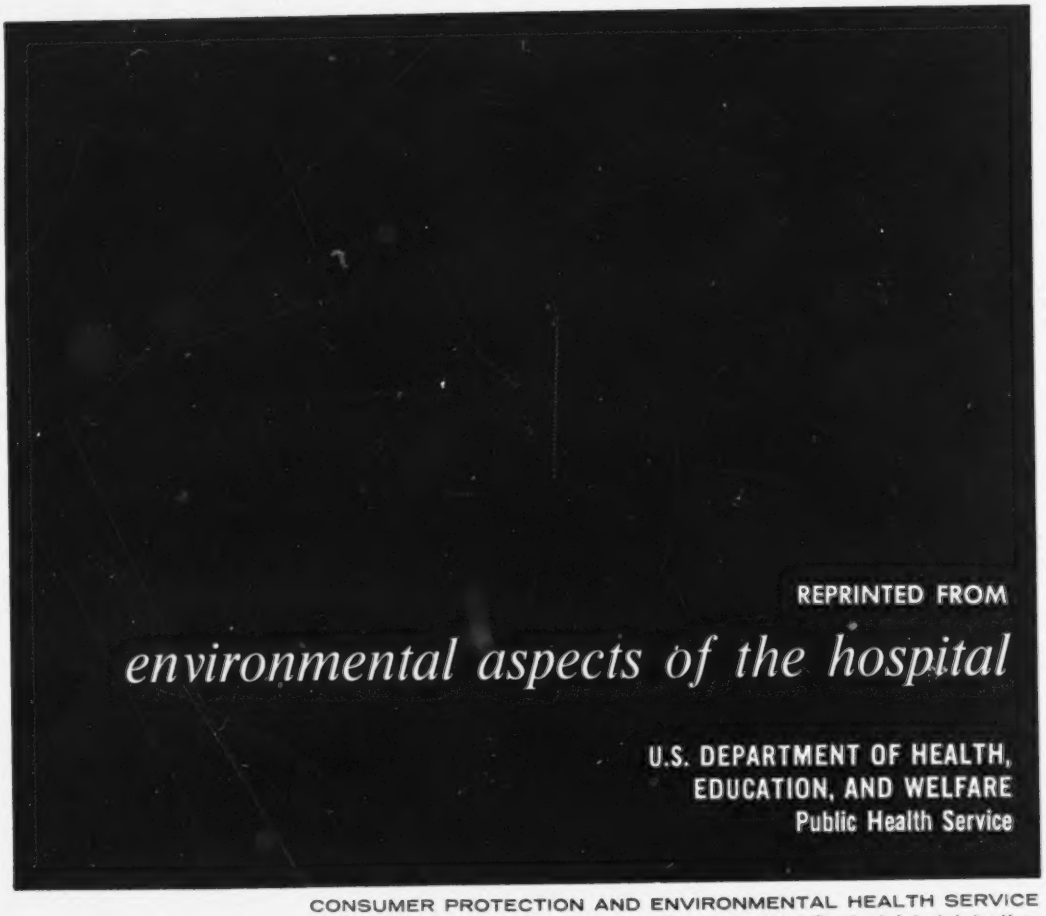


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